METALCASTING

Project Fact Sheet

A HotEye™-Based Coordinate Measuring Machine for the Forging Industry

Benefits

- Could save 1.6 billion Btu of electricity per installation annually
- Could save 0.5 trillion Btu annually by 2010
- Allows 3-D measurement as parts are being forged at temperatures of up to 1450°C
- Provides accuracy of up to 0.1 mm
- Produces high-definition imaging in less than 10 seconds
- Detects and identifies production flaws quickly
- Inspects hot work pieces remotely, reducing employee burns
- Withstands harsh conditions
- Uses standard industry metrology interfaces for utility and flexibility

Applications

The primary customers for the HotEye-based CMM are domestic forging companies that produce high-value parts through a hot-forging process. Both the forging and steel industries have identified an urgent need for advanced imaging systems for defect detection and identification. The technology is also applicable to other industries that use pyro-processes such as hot-rolled steel and glass-making processes.

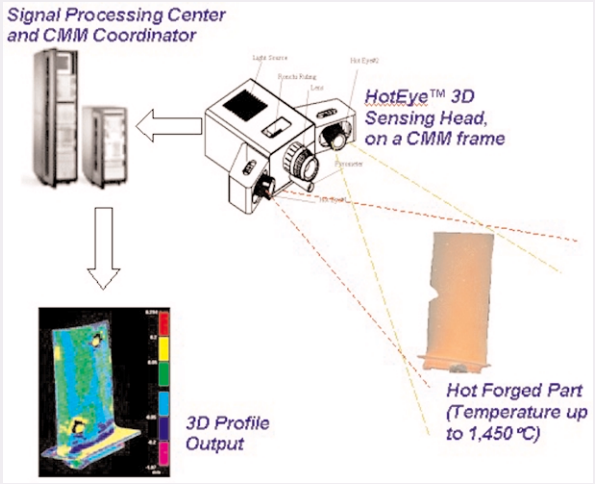
A Unique System for 3-D Measurement Enhances Process Control, Reduces Scrap, and Saves Energy

The HotEye-based machine combines the conventional technology of coordinate measurement machines (CMMs) with HotEye technology to accurately measure forged parts at high temperatures. The unique capabilities of this innovative new technology are expected to dramatically reduce the amount of scrap produced by the forging industry.

Scrap materials comprise more than 15% of total production in the U.S. forging industry, wasting enormous amounts of energy, time, and money. The inability to inspect forged products while they are hot is the primary cause of the high scrap rate. The delay between production and inspection of a part can be substantial, making process control in forging highly problematic.

For example, at a Michigan plant, a forged crankshaft requires an hour for cool-down and an additional 50 minutes for a complete dimensional measurement. If a tool failure occurs and creates dimensional imperfections, the problem will not be detected until 110 minutes after the first bad part comes off the line. During this time, 440 bad crankshafts will have been made, costing the manufacturer $33,000 in productivity loss and wasting 132,000 kWh of energy. For high-value parts, such as titanium alloy components for jet engines, losses can be several orders of magnitude higher.

HotEye-Based Measuring Machine



This new technology, developed by OG Technologies, Inc., allows forging operators an accurate 3-D measurement as parts are being forged at high temperature.

Project Description

Goal: Develop and demonstrate a 3-D imaging system to accurately measure red-hot forging parts using a high-definition camera.

Currently, hot work pieces are inspected with bare eyes for surface defects; a worker then measures the object with hand-held calipers at a dangerously close range. Only limited and inaccurate data can be collected in this way. The HotEye-based CMM provides a room-temperature image of a 1450°C object by filtering out all the incandescent radiation at a safe distance. The innovation consists of integrating HotEye technology into a stereo-imaging-based 3-D measuring system. The design, developed in the machine vision industry with the use of regular charge coupled device cameras, will facilitate stereo imaging and provide accurate 3-D profiling.

OG Technologies, Inc., is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in U.S. Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Develop a 3-D sensor head that can measure a part at 1450°C, to 0.1 mm, and with a scanning speed of less than 10 seconds for an area of 100 mm x 100 mm.
- Develop virtual-fixturing software to alleviate the need for precise hard fixturing.
- Integrate into a standard CMM, including hardware and software, so that the system can perform a complete preprogrammed measurement of a hot product.
- Build, test, and refine the prototype.
- Revise market information and business plan based on system performance.

Economics and Commercial Potential

The U.S. forging industry has annual sales of $6 billion and consumes 1.67 billion kWh of electricity annually. Because of the 15% scrap rate (industrial average), however, the industry loses approximately $1 billion in productivity. Its continued viability depends, in part, on developing tools that allow parts to be inspected and measured without a cool-down period. Approximately 500 forging operations, the potential users of the HotEye-based CMM, exist in the United States. The estimated total domestic market for the HotEye-based CMM is $150 million, with the foreign forging industry adding $750 million.

When a forged part is scrapped, nearly all of the energy put into it is wasted. The HotEye-based CMM can eliminate 7 of the top 10 yield-loss factors in the forging industry, reducing the scrap rate from 15% to 4.3% to achieve a 10.7% increase in overall yield. This improvement can be mapped to potential energy savings of up to 1.2 trillion Btu annually. Reducing scrap also saves the energy needed to recycle the rejected metal pieces, estimated to be twice as much as saved in the forging process. This technology could save 1.6 billion Btu per installed unit each year. First sales for the technology are expected by 2003. Based on 40% market penetration by 2010, annual savings could be 0.49 trillion Btu with 300 units installed. Market penetration of 60% by 2020 could save 0.74 trillion Btu annually from the operation of 450 units.

Industry of the Future—Metalcasting

The metalcasting industry – represented by the American Foundrymen's Society (AFS), North American Die Casting Association (NADCA), and the Steel Founders' Society of America (SFSA), has prepared a document, ***"Beyond 2000,"*** *to define the industry's vision for the year 2020. OIT's Metalcasting Vision Team partners with metalcasters, national laboratories, universities, and trade/environmental/technical organizations to develop and implement energy efficiency technologies that benefit both the industry and the United States. Recently, the Metalcasting Team facilitated the development of the Metalcasting Technology Roadmap, which outlines industry's near-, mid-, and long-term R&D goals.*

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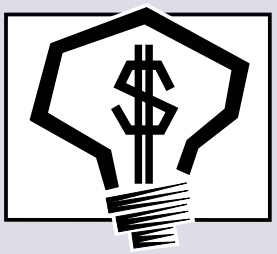

The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

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